DOCUMENT RESUME

ED 062 650 CG 007 173

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TITLE	Suggestions for Treatment of Information About Occupations.
INSTITUTION	Harvard Univ., Cambridge, Mass. Graduate School of Education.
SPONS AGENCY	Office of Education (DHEW), Washington, D.C.
REPORT NO	Proj-R-4
BUREAU NO	BR-6-1819
PUB DATE	Dec 66
GRANT	OEG-1-6-061819-2240
NOTE	22p.
EDRS PRICE	MF-$0.65 HC-$3.29
DESCRIPTORS	Career Choice; Career Planning; Computers; *Data Bases; Data Processing; Guidance; Guidance Counseling; *Information Retrieval; Information Storage; Information Systems; Input Output Analysis; *Man Machine Systems; *Occupational Choice; *Occupational Information; Occupations; Vocational Development; Vocational Interests
IDENTIFIERS	Information System for Vocational Decisions; ISVD

ABSTRACT

This is a working paper which seeks to examine how information about approximately 900 occupations might be utilized and kept up to date. The discussion centers on a modular system for information treatment. The paper elaborates on: (1) how and what kinds of information will be put into the system; and (2) five different modes of operation for getting information out of the system. These latter include: (1) recall by occupation, industry, or trait; (2) selection by trait; (3) selection by multiple traits; (4) selection by scoring and evaluation; and (5) planning to implement vocational decisions. Inquirer/system interactions for each mode are specified. The components and structure of the proposed information system are discussed, and diagrams included. The author concludes by listing several subsequent steps which need to be taken toward the goal of making such a system optimally usable. (TL)

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ED 062 650

INFORMATION SYSTEM FOR VOCATIONAL DECISIONS

Project Report No. 4

SUGGESTIONS FOR TREATMENT OF INFORMATION ABOUT OCCUPATIONS

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This paper was supported in part by Grant No. OEG-1-6-061819-2240 of the United States Office of Education under terms of the Vocational Education Act of 1963.

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December, 1966

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SUGGESTIONS FOR TREATMENT OF INFORMATION ABOUT OCCUPATIONS

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Introduction

During the past summer my colleagues at CSED put together a great deal of information about quite a lot of occupations (c. 900), arranged it in orderly form, and placed it on magnetic tape for future processing. One of the next problems we face is how this information should be used and kept up to date. This has been discussed on various occasions, but usually in a very general way.

This working paper seeks to examine in more explicit terms how we might proceed in our use of this information. I have incorporated here many ideas and suggestions from other workers. Much of this material will therefore be familiar. But I hope some purpose is served in collecting and recording these ideas before going on to more detailed work.

The discussion centers on a modular system for information treatment. We expect to develop our data and methodology consistent with the lines indicated, working closely with Ellis' group throughout.

Although I have not relied directly on the Tiedeman paradigms, I hope that my approach will prove compatible with them.

General Goals

This paper follows certain principles I believe vital to the success of our work. First, our primary task with regard to information should be synthesis. We should avoid developing raw data (we haven't the resources), but should collect it in as refined a form as we can, consistent with our needs. We should not put as much effort into deciding on the validity of information as into preparing for its use, development, and variation. Second, experimentation with the form and content of vocational information, regarding both occupations and industries, will go on for a long time, and our system must be prepared with this in mind. This will be possible only if the system is conceived as an interconnected set of individual parts each of which can be removed, improved, or replaced with minimum disruption of operation. In this way we can start with minimal capability, and allow the system to evolve, part by part, as our understanding develops.

There are several ways in which we might use our information about occupations. First, we should like the student inquirer to be able to query the system directly about the characteristics of a broad range of given jobs ("What does a candle snuffer do?", "What high school courses does a chicken sexer need?") or industries ("How many people work in the auto industry?"). He should also be able to select occupations or industries in terms of chosen characteristics ("Which jobs involve a great deal of travel?"). Compound questions should also be possible ("Which jobs involve a great deal of travel,

working primarily with things instead of people, and require no mechanical aptitude?"). He ought also to be able to get suggestions for possible jobs by stating his preferences ("I like working with things and being out of doors."). It should be possible, too, for the system to suggest and guide his inquiry if he is unsure how to proceed.

Not directly related to the inquirer, but vital to the proper operation of the system, will be the ability to organize, update, and revise information. Two sources seldom occur in the same form, but it is important to be able to use them all. To achieve the needed flexibility as a part of normal operation, the modular design suggested above will be relied upon. If there is to be a suitably free dialogue between the system and the inquirer, flexibility of input and output (communication between inquirer and system) will also be important.

Putting Information into the System

The information that the system will use is of two types: information about the inquirer, and information about the existing jobs. The latter information will include both occupations and the industries in which they occur. This will be stored within the system and not vary from interview to interview. It will be changed only as a part of system revision. The information about the inquirer, on the other hand, will be temporarily kept in the system only for the duration of the interview (plus whatever permanent interview records are decided upon). This includes both objective information

(e.g., personal data, grades, test scores) and subjective statements which will guide the course of the interview.

Each source of information about occupations or industries tends to be broken down according to different categories. For the compatible use of all sources, we cannot take them directly, but must translate to a standardized set of categories. This was done by hand in the initial collection of information about 900 jobs. Hopefully, translation routines can be developed to make this task automatic in the future. A standardized structure, and the treatment and translation of the individual sources within it, must be prepared soon, and with considerable care and attention.

Getting Information Out of the System

Information about occupations and industries will be stored for the express use of students in choosing and planning their educations and careers. It is essential, therefore, that it can be recalled as will best serve their ends. Ways of getting information out of the system will be described here in terms of five principal modes of operation.

MODE 1 - SIMPLE RECALL BY OCCUPATION, INDUSTRY, OR TRAIT

In this simplest mode, the inquirer asks for specific information about a given occupation or industry. He may make this request in informal language, but the system will probably interpret it in one of several structured forms, e.g.,

"Does a (x) (y)?" ("Does a candle snuffer travel a lot?")

"Are (x)'s required to (y)?"

"Are (x)'s often employed in the (y) industry?"

The number of such forms should be limited, but carefully chosen to allow a comprehensive range of questions. The system will search under the given occupation and recall the desired information, preferably through a statement in the English language. It should also be possible to call forth a short prose composition about the job or industry, which has previously been stored for this purpose. Other information and references for further investigation of the occupation might be included, as well as a routine for the translation of unlisted requests into listed occupation or industry titles.

MODE II - SELECTION BY TRAIT

In this mode the system will begin to help the inquirer select jobs which can then be more fully examined under Mode I. A given trait is chosen by the inquirer and the names of all those stored occupations having this trait is made available by the system. This will involve selecting from the stored list of occupations on the basis of desired traits.

Examples: "Which occupations involve some but not a lot of travel?"

"Which occupations involve college education but not an advanced degree?"

The types of queries possible will be made known to the inquirer so he can use the system fully and effectively. The output will be given to the inquirer piece by piece at his request and in a predetermined order (e.g., starting with the jobs most in demand) to avoid swamping him with a lengthy list.

The inquiry need not in fact be in terms of named occupations or industries, but might relate traits directly, e.g., "Are indoor jobs likely to involve more or less travel than outdoor jobs?"

MODE III - SELECTION BY MULTIPLE TRAITS

As a logical extension of Mode II, the system can help the inquirer select possible jobs by doing some preliminary sorting for him. He will of course be free to revert to one of the lower numbered modes for further information. In Mode III he will list some traits he wishes his job to have or not to have. He might also at this point introduce test scores and other objective personal information to further help the system to select suitable occupations.

The system will eliminate occupations in the manner of Mode II until all requirements indicated by the inquirer have been used. If the list is not evacuated by this process (i.e., if the subject is not so fussy that no jobs can please him) the system will proceed as follows:

> "There is a list of (x) jobs suitable by your criteria."
>
> "All of these have the following traits in common: (u), (v),.... (w)."
>
> "The following additional traits are possessed by at least one of these jobs: (a), (b),.... (c)."

The inquirer can then further refine his choice by adding, changing or eliminating certain traits. Or he may call for the derived list, which he can then examine in the manner of Mode I.

If the inquirer's desires are so severe that he gets a vacant list, he can try again, or be offered a list of occupations that differ

in only one respect from his requirements. In this way he can be helped explore the job list until he finds a suitable job or set of jobs to investigate in more detail.

MODE IV - SELECTION BY SCORING AND EVALUATION

This is an extension and refinement of Mode III, and can be considered either in addition to or instead of it. Here the inquirer not only specifies traits, but evaluates them in words ("like," "dislike," "like very much," "dislike mildly"). The system will translate these statements into numerical scores according to pre-established rules. The scoring might be further refined by asking the inquirer to attach weights to his preferences (e.g., indicating that his desire to make a certain minimum income is much more important than his objection to a lot of travel). Each job will then be given a score on this basis, and a list ordered by decreasing score made available for the inquirer to draw upon.

This scheme is liable to the objection that the inquirer seems to have a choice being made for him without his full control, since he will not fully understand the things the system will be doing to make this ordered list of jobs. This objection need not be a valid one. The entire list is available to the inquirer. He can sample as much of it as he likes. And he can revert to the other modes for further information whenever he desires. Also, he might be shown on request how each job obtained the score it did on the basis of his stated preferences. He can then if he wishes, change or add to these preferences and see how this affects the scoring.

In effect he is being allowed and helped to write a computer program for job evaluation based on his own needs, in a very specialized, but still somewhat flexible programming language.

MODE V - PLANNING TO IMPLEMENT VOCATIONAL DECISIONS

The previous modes helped the inquirer to examine single job possibilities. It can also help him hedge his decisions against risk by planning composite programs that will leave satisfactory alternatives open to him in case his first choice fails. The system can help him anticipate and plan in detail for his future in terms of school courses, time, costs, risks, and in the selection of colleges, training programs, and entry occupations.

In Mode V the inquirer will indicate to the system a set of jobs that interest him. The system will respond with information about the preparation needed for this set as a whole, the rewards and risks involved, and perhaps other relevant information. The inquirer can thereby examine what various possible decisions would imply, and be thus aided in making a career decision that suits him.

In each mode except the first, the inquirer will sometimes call information from the system, and sometimes be given information automatically. Mode I will involve only recall at the command of the inquirer. In the higher modes, the system will sometimes volunteer information of particular importance. This will include suggestions designed to help him decide what further information to request or to put into the system.

RELATION TO PARADIGMS

Although the modes of operation suggested here were not selected with the ISVD paradigms in mind, a rough relation between modes and paradigms is possible:

Paradigm: Exploration - Modes I, II;

Crystallization - Modes II, III, IV;

Choice of Planning - Modes III, IV, V;

Clarification - Modes V, I.

There is not a one-to-one correspondence here between modes and paradigms, nor should there be. The student's use of the system from paradigm to paradigm will be facilitated if there is some overlapping. It is also interesting to note that the paradigm sequence both begins and ends with Mode I.

System Components

The components and structure of the information system implied by the above outline will now be discussed separately. The components, briefly described, are listed below.

Input Translator - will convert the questions and requests of the inquirer into the form in which the system will handle them. The degree to which we must restrict the language that the system can accept has yet to be decided. Structured inquiry will generally be cheaper to accommodate than natural language, but has the disadvantage of limiting the dialogue between inquirer and system. One advantage of modular design is the possibility of starting with less than ideal elements (in this case a highly structured communication between inquirer and system) and then improving system capability

by gradual and separate improvement of each of its elements.

Inquiry Record - a list for future reference of what the inquirer asks the system for in Modes I and II. In Modes III, IV, and V, when the inquiry develops into a dialogue or interview, this will become known as the Interview Record.

Interview Record - a list for future reference of what the inquirer has asked for during his interview with the system and what the system has responded.

Information Sources - the raw material on occupations and industries, in a form as well adapted for system use as possible.

Information Translator - will convert the source information into a form suitable for formal system operation. At first this translation will be manual, but we can hope eventually for machine translation within limits.

Information Store - the repository of information translated from the information sources and ready for use in system operation. This store will vary somewhat from mode to mode, or might be adapted to serve more than one mode simultaneously. In general it will be divided into an addressable list, to which requests for information can be keyed, and a passive list, from which information can be recalled but which cannot be addressed directly. It may at some later time be better to think in terms of a set of several such information stores, suitably linked to one another.

Sorter - will select information from the information store according to the preferences and requirements of the inquirer, and

prepare this information in a form suitable for his use in Modes I, II, and III. In Mode IV this role is taken by the Evaluator, and in Mode V by the Requirements Processor.

Selection - the result of the sorting process, when this result is a single piece or set of information (Mode I).

Selection List - the list of items that result from the sorting process, ordered in some predetermined fasion so that they can be recalled one by one or in groups by the inquirer to meet his information requirements.

Output Translator - will convert the results of system operation into a form intelligible to the inquirer. This may include changing code to words and numbers; constructing sentences, tables, and graphs; or calling up audio or visual presentations. This is an important element and deserves considerable attention, though the problem here is less than that for the Input Translator because the format of the response is under the control of the system. The output translator should be able to reproduce the inputs to which it is responding as well as report the results of the sorting and other selection processes.

Trait Union List - in Mode III, the list of traits held by at least one of the jobs on the inquirer's Selection List.

Trait Intersection List - in Mode III, the list of traits held by all the jobs on the Inquirer's Selection List.

Evaluator - will evaluate (in Mode IV) the various jobs in the Information Store and list them in order of decreasing total score, according to the objective traits and subjective preferences

of the inquirer.

Evaluation Register - the list of jobs obtained by the Evaluator in Mode IV in decreasing order of total score, with perhaps some information explaining how that score was obtained.

Requirements Processor - in Mode V, the requirements for preparation for and entry into various jobs will be listed and combined by this processor, in seeking feasible combinations of actions that will prepare the inquirer for an acceptable set of alternative careers.

Plans Register - in Mode V, the summary of actions, expenditures, etc. that the inquirer must go through to prepare for a chosen career or package of careers.

System Structure

The way in which the components just listed will fit together to function as a system must be described separately for the several modes of operation. This is done here in pictorial form (Figures 1-5). The arrows in the figures indicate communication from one component to another. The rectangular elements are permanent parts of the system and will not change from interview to interview except for changes in or updating of the system itself. The circular elements relate to the individual interview.

Figures 1-5 are meant to give only a rough schematic idea of how the system will function. Each of the components shown in the figures and mentioned in the preceding section will be a complex entity that must be designed with considerable attention. The present

intent is to indicate only the nature of these components, and to identify them for subsequent development.

Each mode of operation includes input and output translators, information sources and translators, and an information store. The nature of these common components might well be different for the various modes, particularly in the case of the input and output translators. We will do well to start with the simpler modes and work toward the more complicated ones, including the capabilities developed for the simpler ones as part of each successive stage. Thus, for example, Mode I is available to each of the higher modes to answer specific questions from the inquirer as they arise.

The various system components and the operating modes in which they occur are summarized in Table 1.

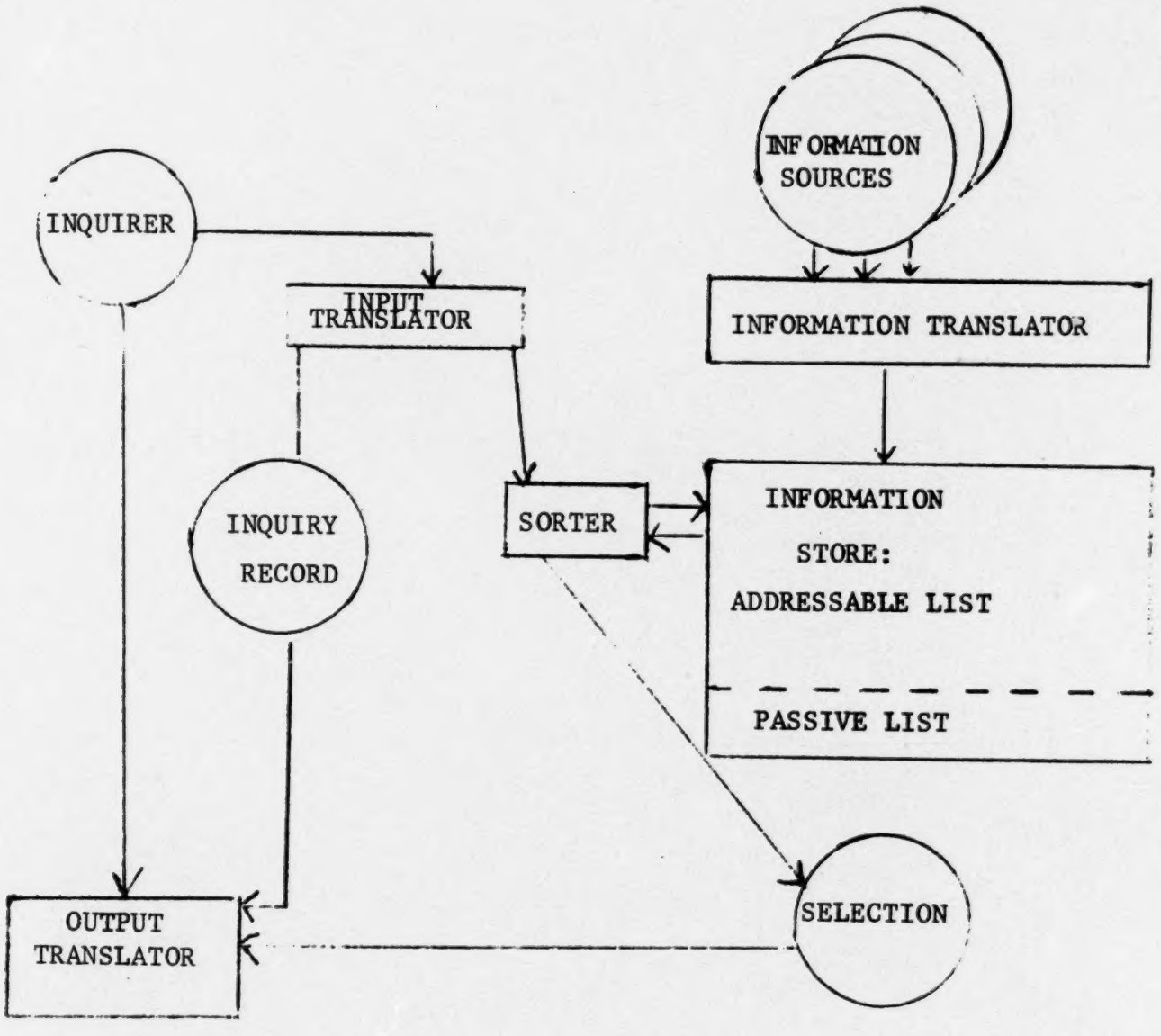

Figure 1

STRUCTURE OF SYSTEM OPERATION FOR MODE I

(Simple Recall by Occupation, Industry, or Trait)

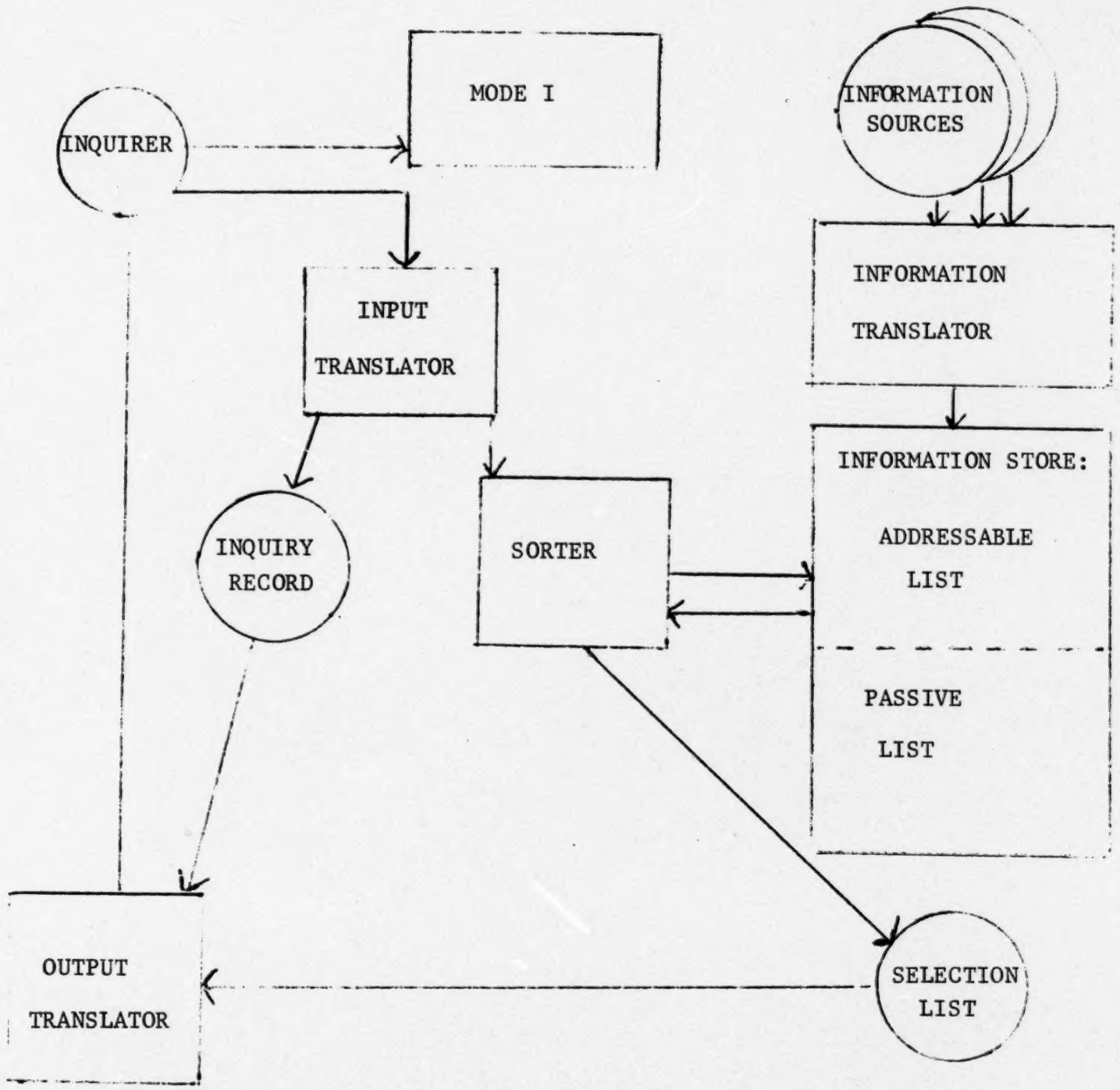

Figure 2

STRUCTURE OF SYSTEM OPERATION FOR MODE II

(Selection by Trait)

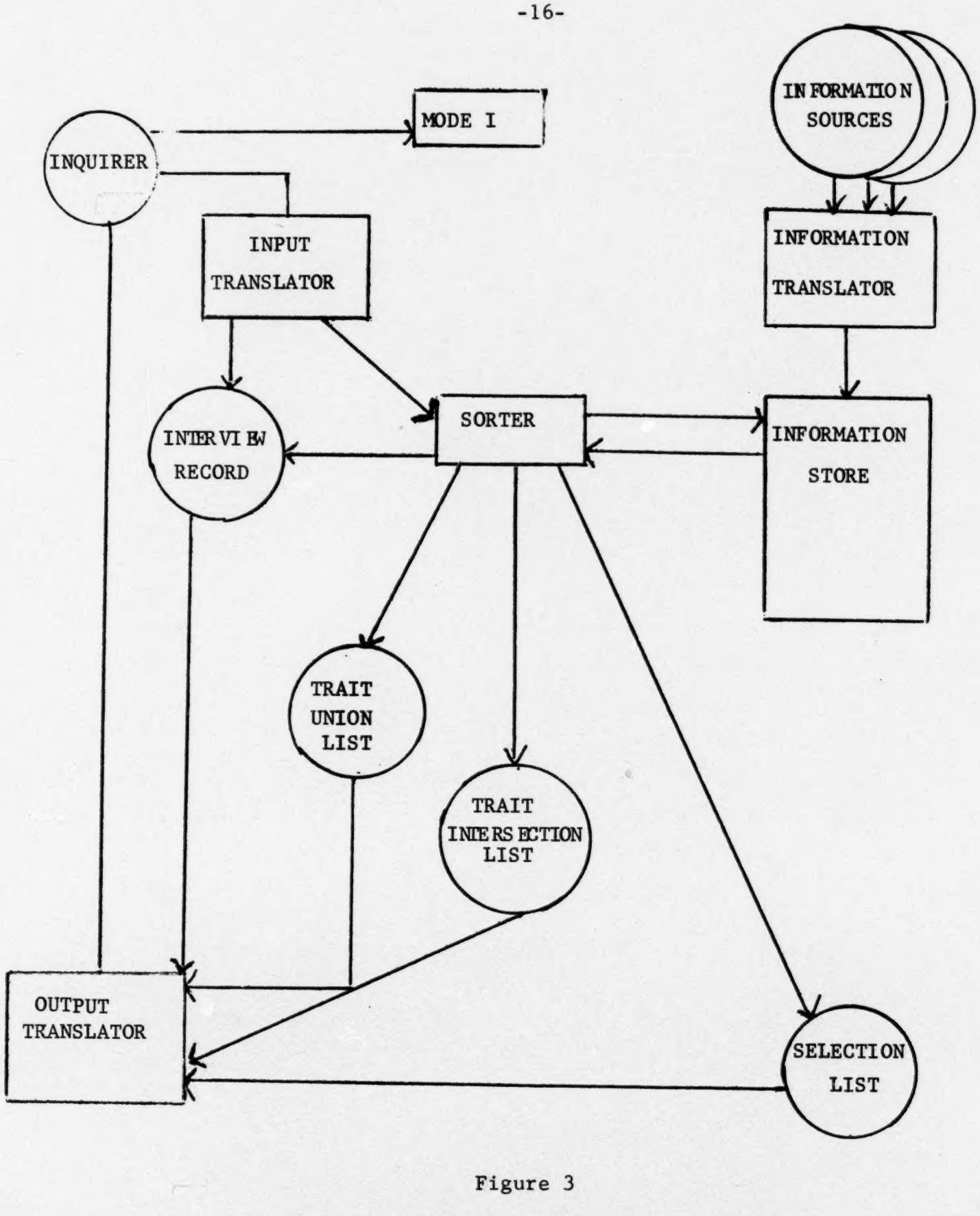

Figure 3

STRUCTURE OF SYSTEM OPERATION FOR MODE III

(Selection by Multiple Traits)

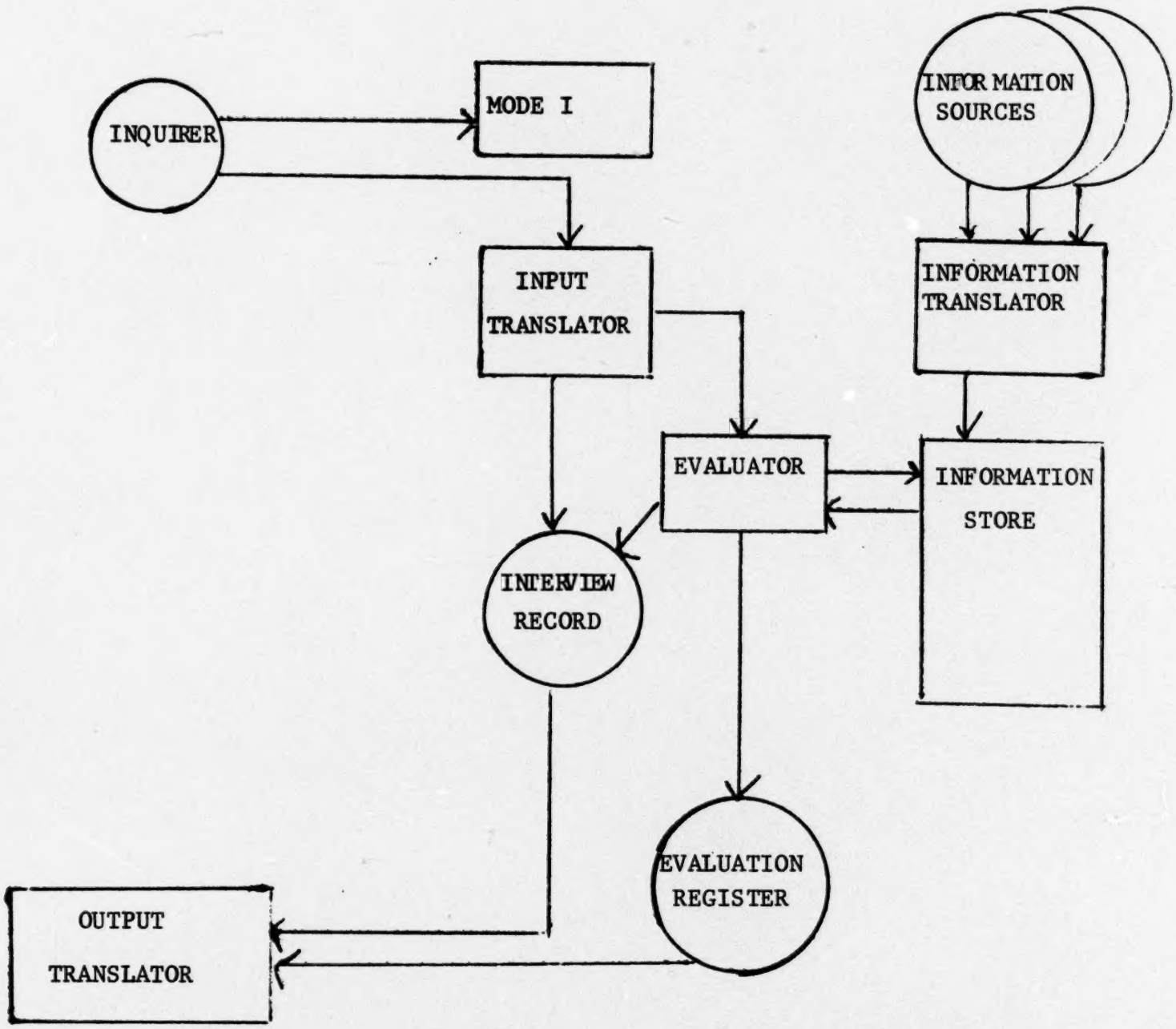

Figure 4

STRUCTURE OF SYSTEM OPERATION FOR MODE IV

(Selection by Scoring and Evaluation)

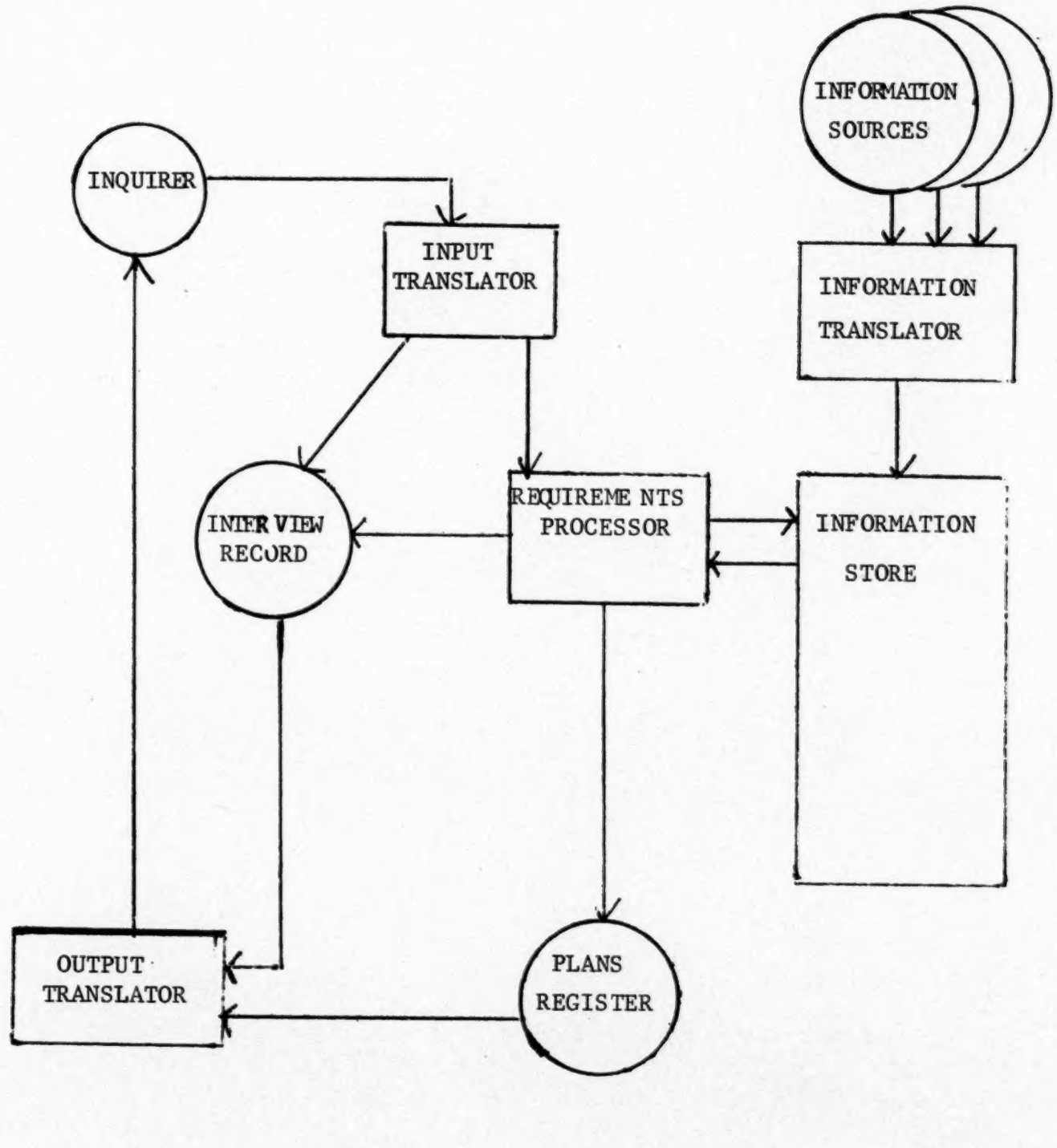

Figure 5

STRUCTURE OF SYSTEM OPERATION FOR MODE V

(Planning to Implement Vocational Decisions)

	MODES				
	I	II	III	IV	V
INPUT TRANSLATOR	x	x	x	x	x
INQUIRY RECORD	x	x			
INTERVIEW RECORD			x	x	x
INFORMATION SOURCES	x	x	x	x	x
INFORMATION TRANSLATOR	x	x	x	x	x
SORTER	x	x	x		
INFORMATION STORE	x	x	x	x	x
SELECTION	x				
SELECTION LIST		x	x		
OUTPUT TRANSLATOR	x	x	x	x	x
TRAIT UNION LIST			x		
TRAIT INTERSECTION LIST			x		
EVALUATOR				x	
EVALUATION REGISTER				x	
REQUIREMENTS PROCESSOR					x
PLANS REGISTER					x

Table 1

RELATION OF SYSTEM COMPONENTS
TO MODES OF OPERATION

Conclusions

The path ahead is fairly clear if we think in terms of handling the simplest modes first. We already have information inputs from several sources, with more readily available. The former have been translated by hand to an information store that is well enough structured for initial experimental processing. Working on this base, we need to consider several subsequent steps. The order of the list below is correlated, though probably not perfectly, with the sequence in which these tasks should be done.

1. Development of prototype input and output translators, so the data can be quizzed experimentally in English. This might to some extent follow the form of McDade's recent memorandum on quizzing the data base, and/or rely on ready-made programs.
2. Preparation of means for searching the information store. This capability is probably in part available ready-made in the programs that Ellis has gathered.
3. Experimentation with live inquirers to see how some of the early modes will work out. If the amount of information becomes a practical problem, the abbreviated list of jobs supplied to us by I. Lerer could be used.
4. Examination of possibilities for better structuring of the information central store, and possible mechanized procedures for translation from information sources to the information store.

5. Development of detailed forecasting methods, using the computer. Besides the forecasts themselves, we might hope these would yield insight into information structure, and how the higher modes might be implemented.
6. Preparation for more advanced sorting techniques (as suggested under Mode IV) and for scoring and evaluation algorithms (Mode V).

Correction, improvement, and expansion of the data base can be expected to continue throughout.

In general, it looks as though the logic of information treatment should be fairly straightforward, though it requires careful attention. The translation routines, particularly for input, and the proper design and use of the information store will likely be the really difficult part.

As a stimulus to discussion I should like to suggest the following questions as representative of the kind we must soon answer.

> Do the suggestions made here call on a reasonable level of computer technology, particularly insofar as software is concerned?
>
> Does the proposed modular form indeed provide the open ended flexibility of system operation and development we seek?
>
> Can we adapt this approach to all kinds of information, from the most structured and quantified to the most qualitive?
>
> Can we update, amend, and revise the information easily, and readily make changes in the method of processing?